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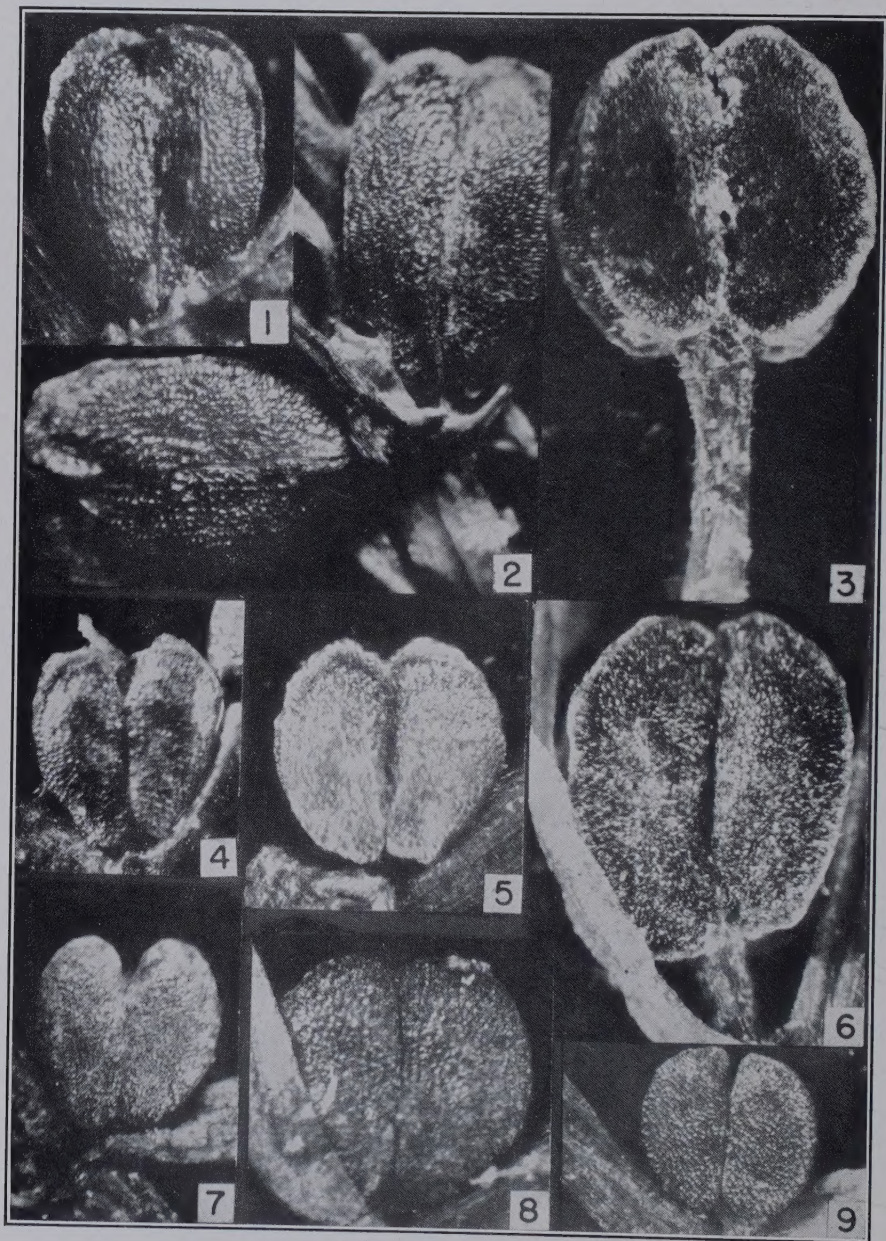
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FRUITS OF CALLITRICHE

Photos by Langdon Divers

Rhodora

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CALLITRICHE IN THE NEW WORLD

NORMAN C. FASSETT

THIS treatment of the species of *Callitriche* occurring in the Western Hemisphere, from Alaska and Greenland to Cape Horn, was started in the summer of 1945 while the writer was working at the Smithsonian Institution under a grant from the Wisconsin Alumni Research Foundation. Continued study has been made possible by the generous loans of material from many herbaria, including: Gray Herbarium (GH); Missouri Botanical Garden (MO); New York Botanical Garden (NY); United States National Herbarium (US); University of California (UC); Universidad Nacional de La Plata (LP); Instituto de Botanica, São Paulo (SP); Chicago Museum of Natural History (CM); New England Botanical Club (NEBC); Oberlin College (OB); University of West Virginia (WVA); University of Tennessee (TENN); University of Georgia (GA); herbarium of Mr. R. F. Thorne; University of Wisconsin (WIS).

For assistance in the interpretation of the morphology of various structures, I am indebted to my colleagues, Professors Emma L. Fisk and Richard I. Evans, and to Professor Arthur J. Eames.

Ranges are plotted on outline maps copyrighted by McKnight

PLATE 1167

Fruits are shown 64 times natural size. Photographs by Langdon Divers.
Fig. 1. *C. verna*. Quebec, Fassett 27795 (WIS). Fig. 2. *C. verna*. Colorado, Mackenzie 359 (MO). Fig. 3. *C. longipedunculata*. California, Hoover 776 (UC). Fig. 4. *C. heterophylla*. Tennessee, Svenson 10151 (WIS). Fig. 5. *C. heterophylla*. New Jersey, Adams 298 (GH). Fig. 6. *C. longipedunculata*. California, Mason 5193 (UC). Fig. 7. *C. heterophylla*. Massachusetts, Harper (WIS). Fig. 8. *C. heterophylla* var. *Bolanderi*. Washington, Muenscher 9949 (WIS). Fig. 9. *C. heterophylla*. Illinois, Schneiders in 1893 (WIS).

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The taxonomy of *Callitriche* is difficult. Most species are polymorphic (see Plate 1168, with 10 individuals of one species), and individuals of very similar form may be found in different species. Fruit is therefore necessary for identification in all cases. While fruits are present on a majority of collections, they are often evident only after considerable search with a low power binocular microscope. Most fruits are a millimeter or less in diameter so that close inspection is necessary to see the minute characters used to differentiate species. Magnification of at least 20 times is necessary, and 30 times is often better. Size and proportions of fruit, presence or absence of wings, nature of the commissural groove as shown in a cross-section, and sometimes the surface markings of the mericarps account for most of the key characters.

The nomenclature of *Callitriche* is difficult. Nearly every early name was based entirely on foliage characters that are paralleled in many species. Most of these names are, therefore, *nomina ambigua*, and their list includes some of the best-known in the genus: *C. verna*, *C. palustris*, *C. heterophylla*, *C. autumnalis*, *C. hermaphroditica*, *C. stagnalis*, *C. turfosa*, and *C. terrestris*. It has therefore been necessary to fix the applications of these names (in absence of type specimens) by the usage of the first writer to describe the fruit. Happily, this does not result in any major upsets in nomenclature. *C. terrestris* Raf., interpreted by Torrey in 1826, replaces *C. Austini* of American literature, described in 1867 (and based incidentally on a mixture of 3 species). *C. palustris*, used by most recent American authors, gives way to *C. verna*, the traditional name in European literature; both names were used in an indefinite sense by Linnaeus, and *C. verna* was first precisely interpreted in 1831, *C. palustris* not until 1897 in Britton & Brown's Illustrated Flora.

STRUCTURE OF THE FRUIT OF CALLITRICHE

Several fruits are illustrated, natural size, in Fig. 3, 5, 7, 8 and 9 on Plate 1169, where they appear as round dots about a millimeter in diameter in the leaf-axils. Enlarged photographs are shown in Plate 1167.

The fruit of *Callitriche* consists of 2 carpels, each of which is divided into 2 one-seeded mericarps (Fig. 1b). The orientation of the two stigmas, as shown in Fig. 4a and 5a, suggests that the true partition between carpels is the one lying horizontally in Fig. 4c, so that in a face view of the fruit, like Fig. 3b, only one carpel is visible. The false partition then appears as a facial groove, visible as a straight line up and down the middle of the fruit, in Fig. 2b, 3b, 4b, 5b. The commissural groove, or groove between carpels, appears only when the fruit is viewed from one edge, as in Fig. 11b, 12b, etc., or is seen in cross-section when the two commissural grooves appear at the two ends as in Fig. 1b, 2c, 3c, and 4c.

The surface of the mericarps appears reticulate on the dried fruits. Plate 1167 shows photographs of dried fruits. Fig. 3d, 4d, 13d, 13i, 13v, etc., are camera lucida drawings of pericarps stripped from fruits that have been cleared by boiling in KOH. The actual nature of the reticulate surface is shown in Fig. 13q, a portion of a section made by my colleague, Professor Richard I. Evans, from fresh material. The drawing shows, starting at the outside (the top in the drawing): the pericarp, consisting of 2 or 3 layers of very thin-walled cells and a layer of cells with all but the outer wall thickened; the seed-coat, a single layer of very thin cells; the endosperm, of large oval loosely packed cells; and the embryo, of smaller, conspicuously nucleated cells. The reticulate appearance is due to the collapse of the outer thin-walled cells of the pericarp, so that under the microscope one looks into the cavities of the thick-walled cells.

A fresh fruit just out of the water, viewed with a binocular microscope of 20–30 power, has a remarkable appearance. The lines between the thick-walled cells show as threads of shining silver. There must be a capillary but continuous and branched intercellular space, filled with air, between these cells.

The wings may be of two types. The true wing is a membranous outgrowth from the margin of the carpel (Fig. 4b, 4c) and is of a different texture and has different markings from the reticulate body of the carpel. The wing may have heavy radial markings as in Fig. 3d, 4d, or almost no markings as in Fig. 10v, 23b. There is sometimes present what may be called a false wing. This is best developed in *C. hermaphroditica*, a species usually

described as having a broad-winged fruit. Fig. 24d shows such a fruit; the true wing is very narrow, and the false wing (shaded with a few radial lines) is broad. The false wing is formed, apparently, by the uninflated outer part of the carpel, marked III in Fig. 24c. The nature of the false wing is also shown in Fig. 24b, where it is very conspicuous and no true wing is shown. This contrasts with Fig. 23e which shows the knife-like appearance of the true wing in cross-section. Fig. 24f is a camera lucida drawing of the edge of the carpel of *C. hermaphroditica*, and it shows the very narrow true wing to the right, and the surface of the false wing marked like the ordinary carpel wall.

Some development of a false wing due to incomplete filling of the mericarps by the seeds is shown in Fig. 4 & 5 on Plate 1167.

MORPHOLOGY AND CYTOLOGY

Professor A. J. Eames sends me the following notes on the morphology of the fruit of *Callitriche*:

"There are, as usually described, two carpels each with two marginal ovules. The carpels are flattened dorso-ventrally so that the midrib (with dorsal bundle) lies close to the placental margins. The dorsal (midrib) bundle rarely shows and then only as one xylem element. The ventral or marginal bundles, though weak, are definite. There are the normal two for each carpel. Thus the axile placentation shows a flattened ring of four bundles, a normal condition for axile placentation with two carpels.

"Even in flower the midrib region of each carpel extends ventrally almost to the placenta. Later it apparently extends farther, reaching, with this false partition, the placenta, dividing the locule and separating the two ovules.

"In the mature fruit, dehiscence is through this false partition and the placental region of each carpel. Also the two carpels separate. This morphological condition is closely like that in the mints, and borages.

"The styles stand in normal position over the midribs of the carpels; the stigma is therefore not commissural."

The haploid chromosome number in the Sect. *Pseudocallitriche* is 3; in Sect. *Callitriche* it is 5 in some species, 10 in others, and rarely 19 or 20. This is according to Jorgensen,¹ who also

¹ Bot. Tidskrift 38: 81-122. 1923.

describes the development of the gametophytes and discusses the systematic position of the genus.

SOME TECHNIQUES IN HANDLING SMALL SEEDS AND FRUITS

Small fruits like those of *Callitriche* are difficult to work with. First, a fruit must be located on the sheet. This is best done with a low power binocular microscope, after which an arrow may be marked on the sheet for future guidance, or, better still, a pencil line may be drawn leading among the stems and leaves to the fruit. It is still difficult to compare fruits from two sheets. For this purpose, the most successful technique involves use of a slide of cellulose acetate, perhaps 1 x 1½ inches. The fruit is removed from the plant and placed on the slide; a single drop of acetone will make it adhere to the acetate. Now, the slide can be superimposed on any specimen; it is transparent and a fruit lying below it can easily be compared with the one fastened to it.

Cross-sections of fruits are often necessary (Fig. 1b). A fruit is laid on the acetate slide, and wetted with a drop of acetone. Before the acetone has dried, a drop of a thin solution of cellulose acetate is put on, to imbed the fruit. When this has hardened, two parallel cuts through the middle of the fruit (performed with a razor blade under the binocular) makes a section that can be freed by another cut under the whole fruit. The section is laid flat, and secured by a drop of acetone. If the fruit is sectioned without imbedding the mericarps usually separate.

To determine the nature of the commissural groove an edge view of the fruit is often useful (Figs. 10c, 10f, etc.). The fruit is laid on the cellulose acetate slide and, under a binocular microscope cut lengthwise along the facial groove. Each half-fruit is put in an upright position (the cut surface against the slide) and secured in place with a drop of acetone. Since these pieces are easily knocked off, they may be protected by small pieces of cellulose acetate placed on each side of the preparation and fastened down with a drop of acetone.

For microscopic examination of wings and surface of carpels (Figs. 1c, 3d, 4d) the fruits are boiled in KOH, then washed in water. Each mericarp (the fruit will usually have fragmented by this time) is dissected while still wet, either by squeezing out the seed (under the binocular) or by stripping off the pericarp.

The pericarps are moved to a drop of alcohol on the slide, for dehydration. They are removed from the alcohol and covered with a drop of acetone, another small piece of cellulose acetate is put on for a cover, and the preparation pressed together for a few seconds. The mount is then permanent.

For many collections of *Callitriche*, slides have been prepared in this fashion, showing a fruit in face view, in edge view, and in section, with a piece of pericarp and wing for microscopic examination. These slides appear to be permanent and are being placed in envelopes on the herbarium sheets. I can only hope that they may keep as well as have the meticulously prepared dissections by Dr. Engelmann, which it has been my privilege to examine in the collections of the Missouri Botanical Garden.

These techniques have been described in some detail because they proved to save so much time once they were developed. They may be easily adapted for use in other groups. Seeds and other small objects may be readily mounted on acetate slides, usually with a single drop of acetone that dries in a few seconds. Flowers and other objects that have been boiled for softening and dissection must be dehydrated before being stuck down with acetone; this is readily accomplished by running a small stream of alcohol over the preparation. The slides are easily marked with India ink and may be labelled with collector's name and number, etc., for identification.

For quick repairs to herbarium sheets, cellulose acetate is invaluable. This is particularly true in the case of *Callitriche*, and for other aquatics that have only been floated out on the sheet without adhesive. A very thin solution of cellulose acetate in acetone is used; painted thinly across a specimen or dotted on locally, it secures the plant to the paper, dries in a few minutes, and is visible only with the most careful scrutiny.

THE SECTIONS OF CALLITRICHE

Sect. 1. MICROCALLITRICHE sect. nov., plantae palustres vel subterrestres; foliis subuniformibus; foliorum pilis peltatis nullis aut raris; floribus sin bracteis; antheribus 0.1–0.2 mm. latis; staminibus 0.2–1.2 mm. longis; stigmatibus 0.2–1.2 mm. longis; fructibus plerumque latioris quam longis.—SPECIES TYPICA, *C. deflexa* R. Br.

Section *Microcallitriche* is best developed from southern and extreme western United States southward to Argentina; a few

species are found in Japan, Australia and New Zealand. These are the most nearly terrestrial species of *Callitriche*, and several kinds grow where the soil is only somewhat muddy in the spring and becomes desiccated as the season progresses.

Sect. 2. *CALLITRICHE*. *Eucallitriche* Hegelm. Monogr. Gattung *Callitriche* 54, 1864, emended. Plants aquatic or in mud at the water's edge; most species highly polymorphic, amphibious and adaptable to various depths of water or muddy shores; submerged leaves typically linear, 1-nerved, bidentate at tip, but sometimes obovate and petioled; floating leaves typically obovate, 3-5-nerved, and narrowed to a flat petiole; leaves with peltate scales (Figs. 17c, 17d) that are 4-, 8-, or 16-parted; flowers subtended by two white inflated bracts; anthers 0.2-1.5 mm. wide; stamens elongating to 1.5-3 mm.; styles 0.7-6 mm. long; length of fruit usually equalling or exceeding the width.—As TYPE SPECIES may be named *C. verna* L. emend. Kütz. (*C. palustris* of many American authors).

Section *Callitriche* stands in many respects intermediate between the other two sections. Its members may sometimes be found intermixed with those of one of the other sections. When well submersed its representatives may have only linear leaves and simulate Sect. 3, but when stranded on a muddy shore the same species may be turf-like with only broad leaves to simulate Sect. 1. A single clone may grow partly on the shore and partly in the water and exhibit both life forms at the same time. A very common phase has the lower leaves linear, while the upper ones are broad and crowded in a rosette floating on the surface; these floating rosettes give the common name "Water Starwort." Such plants often show these rosettes much better in their own habitat than on herbarium sheets. Members of this group are found on all continents.

Sect. 3. *PSEUDOCALLITRICHE* Hegelm. Monogr. Gattung *Callitriche* 61. 1864. Plants always submersed; leaves uniform, dark metallic green, often with a slightly darker margin, without peltate scales, nearly linear but actually widest at base, rounded to the bases which are sometimes slightly fused but are not connected by a membranous wing, gradually tapered to the bidentate apex; flowers without bracts; surface of fruit obscurely and irregularly pitted; fruit with a broad false wing and a narrow true wing.—As TYPE SPECIES may be named *C. hermaphroditica* L. (*C. autumnalis* Hegelm., l. c.).

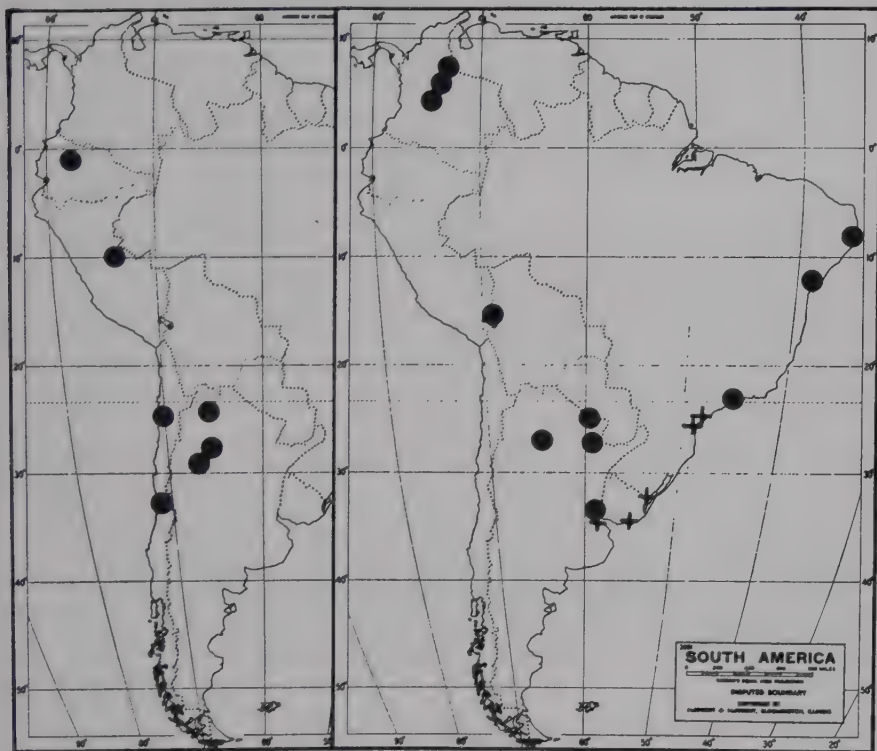
Section *Pseudocallitriche* represents the most aquatic extreme of the genus. Its members occur in cool water throughout Europe and in northern North America.

KEY TO SPECIES OF CALLITRICHE IN THE WESTERN HEMISPHERE

- a. Leaves bright green, of various shapes, the linear 1-nerved ones tapering to a clasping base (Fig. 10w); nodes with a narrow membranous wing connecting the leaf-bases (Fig. 1a, 2a, 3a, 4a, 5a, 7a, 9a, 10g, 10p, 10w, 15b, 16e); surface of fruit usually sharply reticulate.
- b. Fruit broader than high (Figs. 1-7) except in *C. occidentalis* (Fig. 8); stigmas 0.3-1 mm. long (Fig. 1a, 3b, 7a); stamens 0.2-1.2 mm. long and not elongating as the fruit develops; anthers 0.1-0.2 mm. wide; flowers without bracts; leaves and stems mostly without peltate scales; leaves essentially uniform, narrowly oblong (Fig. 5a), or spatulate (Fig. 4a), or broadly oblanceolate (Fig. 1a), 1-3-nerved (often obscurely so); plants mostly terrestrial or on wet mud. Sect. 1. MICROCALLITRICHE.
- c. Fruit 0.5-1.2 mm. wide, not gibbous at base.
- d. Width of fruit exceeding the height by 0.1 mm. (Fig. 1a); face of mericarps convex (Fig. 1b).....1. *C. turfosa*.
- d. Width of fruit exceeding the height by 0.2 mm.; face of mericarps nearly flat (Fig. 2c).
- e. Wing, or margin of carpels, spreading.
- f. Fruit 0.9 mm. or less wide, pedicelled or sessile; wing 0.08 mm. or less wide.
- g. Margin of carpels with a definite scarious wing 0.03-0.08 mm. wide, under high magnification appearing with radial extensions from the brown reticulations on the face of the carpel, these extensions branching and anastomosing (Fig. 2d); stigmas loosely ascending (Fig. 2b), often caducous; leaves 3-veined, the midrib and often the lateral veins evident (Fig. 2a).....2. *C. deflexa*.
- g. Margin of carpels appearing as if not winged but under high magnification showing a wing 0.01-0.03 mm. wide, the radial extensions of the brown reticulations from the face of the carpel simple or forking, not anastomosing (Fig. 3d); styles usually deflexed (Fig. 3b); leaves 3-veined but the veins very obscure (Fig. 3a).....3. *C. terrestris*.
- f. Fruit 0.8-1.2 mm. wide, pedicelled (Fig. 4a); wing usually 0.1 mm. or more wide (Fig. 4b).
- h. Leaves spatulate, the upper 0.8-2 mm. wide, 3-nerved (Fig. 4a); wing of fruit 0.1-0.2 mm. wide.....4. *C. marginata*.
- h. Leaves linear, 0.6 mm. or less wide, 1-nerved or with nearly obsolete lateral veins (Fig. 5a); wing of fruit nearly obsolete.....5. *C. sepulta*.
- e. Wing and thin margin of carpel turned outward at right angles to the surface of the fruit or revolute and appearing like a thickened margin (Fig. 6a, 6b).....6. *C. Nuttallii*.
- c. Fruit 0.3-0.8 mm. wide, more or less gibbous at base (Fig. 7a).
- i. Fruit 0.5-0.8 mm. wide, not quite so high (Fig. 7a, 7b, 7c).....7. *C. peploides*.
- i. Fruit 0.3-0.4 mm. wide, about as high (Fig. 8)....8. *C. occidentalis*.

- b. Fruit as high as wide or a little higher, rarely slightly wider than high; stigmas 0.7–6 mm. long (Fig. 10g, 12g, 15b, 16h); stamens elongating as the fruit matures, to 1.5–3 mm.; anthers 0.3–1.5 mm. wide; flowers with 2 whitish inflated bracts at base (Fig. 10g, Fig. 2 on Plate 1167); leaves and upper nodes usually with peltate scales (Fig. 9a, 13Ad, 17c, 17d, 23j, 23k); plants amphibious, growing entirely submersed or with a terminal rosette of floating leaves, or as a mat stranded on the mud; leaves of various types on different plants or on the same plant (Figures on Plate 1168). Sect. 2. *CALLITRICHE*.
- j. Leaves succulent, connate at base to make a cup about 0.5 mm. deep (Fig. 9a); stems firm and opaque, appearing homogeneous when pressed.....9. *C. antarctica*.
- j. Leaves thin and membranous, connected at base by a very narrow wing; stems weak, pressing flat and membranous except for the firmer stele.
- k. Fruit rarely more than 1.2 mm. wide (–1.5 mm. in a South American species); wing of fruit, if present, sharply demarked from the reticulate face of the mericarp; reticulations, when seen under high power, dark brown or orange, and, under low power (10–30 × magnification) appearing clear and distinct.
- l. Wings of fruit, if present, only on the outside of the mericarps and extending slightly or not at all around the base or summit to the facial groove (Fig. 10a, 18a, 19c, 20c, 21b).
- m. Carpels more broadly rounded toward the summit than toward the base, so that the fruit is slightly heart-shaped (Fig. 10a, 11a, 13e, 13Am, Fig. 1 & 5 on Plate 1167); wing, if present, broadest at the summit of carpels (Fig. 1 on Plate 1167).
- n. Fruit 0.6–1.3 mm. wide.
- o. Height of fruit exceeding the width by 0.2 mm. (many fig. on Plate 1172); surface of mericarps with reticulations tending to run in vertical rows (Fig. 1 & 2 on Plate 1167); lower end of mericarps curved outward so that the fruit is thickest at base (Fig. 10c, 10k, 10u).....10. *C. verna*.
- o. Height of fruit equalling width (Fig. 12a, 12c, 13a, 13Ae), or height 0.1 mm. greater (Fig. 11a, 13d, 13Aa, 13Ap) or less (Fig. 13c, 13m) than width; reticulation of mericarps usually not at all in vertical rows (Fig. 4, 5, 7 on Plate 1167); lower end of mericarps straight so that fruit is thickest a little below the middle (Fig. 11b, 12b, 13f, 13Ab).
- p. Commissural grooves wide (Fig. 11b, 11c); fruit 1.1–1.5 mm. high.
- q. Fruit with well-differentiated white wings at summit (Fig. 11a); commissural grooves slightly U-shaped...11. *C. albomarginata*.
- q. Fruit wingless or with an obscure suggestion of wings; commissural grooves V-shaped.....12. *C. heteropoda*.

- p. Commissural grooves very narrow or edges of carpels in close contact (Fig. 13c, 13g, 13l, 13Ac, 13Af); fruit 0.6–1.2 mm. high 13. *C. heterophylla*.
- n. Fruit 1.5 mm. wide 14. *C. quindiensis*.
- m. Carpels equally rounded above and below (Fig. 15b, 16b, 17a, 18a, 21b), or some fruits narrowed toward base on a South American species with conspicuous wings (Fig. 18k); wing, when present, of equal width around the carpel (Fig. 18d, 19c, 21b).
- r. Width of fruit equalling (Fig. 15b, 17a) or exceeding (Fig. 17e, 18a) the height, or fruit not more than 0.1 mm. higher than wide; fruit sessile except in a variety of *C. Lechleri*.
- s. Stigmas sharply reflexed (Fig. 15b), usually persistent 15. *C. hamulata*.
- s. Stigmas erect or ascending, often caducous.
- t. Carpels wingless
- u. Edges of carpels rounded, with almost no commissural groove (Fig. 16a) 16. *C. anceps*.
- u. Edges of carpels angled, with a wide V-shaped commissural groove (Fig. 17b) 17. *C. nubigena*.
- t. Carpels winged.
- v. Commissural groove deep and V-shaped (Fig. 18c, 18f); fruit slightly wider than high (Fig. 18d), often pedicelled 18. *C. Lechleri*.
- v. Commissural groove shallow and U-shaped (Fig. 19a); fruit almost exactly as high as wide (Fig. 19c), always sessile 19. *C. trochlearis*.
- r. Width of fruit less than the height by about 0.1 mm. (Fig. 20c, 21b); fruit pedicelled.
- w. Fruit 0.8–0.9 mm. high, clearly reticulate on the faces, with an obscure wing on the outer margins of the mericarps (Fig. 20c) 20. *C. oblongicarpa*.
- w. Fruit 1.0–1.4 mm. high, nearly black at maturity, obscurely reticulate on the faces, with a clearly defined wing around the outer margin of the carpels and extending slightly around the base of each mericarp (Fig. 21b) 21. *C. longipedunculata*.
- l. Wing of fruit extending well around the base and apex of each mericarp so that the facial groove is very short (Fig. 22b) 22. *C. rimosa*.
- k. Fruit 1.2–1.7 mm. wide; wing usually conspicuous but not usually clearly demarked from the reticulate faces of the mericarps; reticulations, when seen under high power, very pale, and, under low power, appearing rather obscure 23. *C. stagnalis*.
- a. Leaves dark metallic green, all submersed, linear-lanceolate (Fig. 24j), narrowed to a clasping base, the bases not connected by a wing; faces of mericarps obscurely and irregularly pitted; plants strictly aquatic. Sect. 3. PSEUDOCALLITRICHE 24. *C. hermaphroditica*.



1 (left). *C. turfosa*. 2 (right). *C. deflexa* var. *deflexa* (crosses), and var. *subsessilis* (dots) in South America.

1. *C. turfosa* Bert. emend. Hegelm. *C. turfosa* Bert. Amer. Journ. Sci. 19: 308. 1831, *nomen nudum*; Hegelm. Monographie Gattung Callitriche 59. 1864, in part; Hegelm. Verhandl. Bot. Ver. Brandenburg 9: 13. 1867.—Fruit 0.7–0.9 mm. wide, 0.6–0.8 mm. high, very narrowly winged all around (Fig. 1a), sessile or on peduncles up to 0.4 mm. long; mericarps plump, thinner toward the margins (Fig. 1b); stigmas 0.5–1.0 mm. long, loosely ascending, caducous or persistent; stamens 1 mm. or less long; anthers about 0.2 mm. wide; leaves essentially uniform, 2–4 mm. long, 0.75–1.5 mm. wide, 3-nerved.—On damp soil and in shallow water; Ecuador to northern Chile and eastern Argentina.—**Ecuador:** in Andibus Ecuadorensibus, 1857–9, *Spruce 5053* (GH, MO, NY). **Chile:** Dept. Junín, Carpapata above Huacapistana, 2700–3200 m., June 7, 1929, *Killip & Smith 24386* (US); Agua Dulce, lat. 25° 16' S, Prov. Antofagasta, Dept. Taltal, Nov. 28, 1925, *Johnston 5187* (GH, US); Cechinalcito, Taltal, Nov. 11, 1936, *Montero 2974* (GH); Valparaiso, 1895, *Buchtien* (US). **Argentina:** Dept. Leales, Oct. 5, 1919, *Venturi 482* (US, GH); Dept. Capital, Rio Salé, Sept. 28, 1923, *Venturi 2066* (US); Prov. Jujuy, Dept. Capital, Rio Zapala, 1250 m., Oct. 3, 1938, *Eyerdam & Beelle 26315* (MO, GH, UC); Bosque de la Plata, prov. de Buenos Aires, Nov. 28, 1932, *Cabrera 2247* (LP).

According to Hegelmaier, 1867, *C. turfosa* as originally conceived (but not described) by Bertero, consisted of two entities, treated by Hegelmaier under the names *C. turfosa* and *C. marginata* γ *Lechleri*. Each of these is cited by Hegelmaier from Rancagua and Quillota, Chile, collected by Bertero. The only cited collection available to the present writer that can be definitely associated with *C. turfosa* is *Spruce 5053* from Ecuador which was not actually seen by Hegelmaier but included on the authority of Engelmann. The best clue afforded by the descriptions to the application of names to these two Andean species is in relative size of fruit: "Frucht gross" in *C. marginata*, including γ *Lechleri*, and "Frucht klein" in *C. turfosa*. The fruits of what is here recognized as *C. turfosa* are 0.7–0.9 mm. wide, while those of *C. Lechleri* are 1.0–1.4 mm. wide.

2. *C. deflexa* A. Br. ex Hegelm. Monogr. Callit. 58, t. 3. 1864; Hegelm. in Martius, Fl. Bras. 13, pt. 2, col. 13. 1882.

Fruit 0.5–0.9 mm. wide, 0.3–0.7 mm. high, sessile or on pedicels up to 4 mm. long; wings usually 0.03–0.08 mm. wide, nearly uniform around the fruit (Fig. 2b), with radial markings produced by the greatly anastomosing extensions of the markings from the faces of the carpels; stigmas 0.3–0.4 mm. long, irregularly erect or occasionally somewhat recurved, often caducous; anthers 0.1–0.2 mm. long, on filaments 0.2–0.5 mm. long (Fig. 2a); leaves 2–4 mm. long, 0.8–2.3 mm. wide, the midrib and often the two lateral veins evident.—Mexico to Argentina.

As first described in 1864, *C. deflexa* included plants with pedicelled fruits and those with sessile fruits, North American as well as South American. The specific name probably came from the deflexed stigmas of the North American component (here separated as another species), but the Brazilian plant with long

PLATE 1168

All figures are *C. heterophylla*, and are natural size, made by direct photographic prints from the pressed plants. All collections are in the Gray Herbarium.

Fig. 1. Virginia, Fernald & Long 9969. Fig. 2. New Jersey, Bartram in 1917. Fig. 3. New York, House 20174. Fig. 4. Rhode Island, Reynolds 068. Fig. 5. New York, Raup 7697. Fig. 6. Maryland, Smith in 1881. Fig. 7. New York, Raup 7794. Fig. 8. Virginia, Fernald & Long 9970. Fig. 9. Connecticut, Andrews in 1895. Fig. 10. Massachusetts, "Local Collection" in 1895.

PLATE 1169

All figures are natural size, made by direct photographic prints from the pressed plants. All collections are in the Gray Herbarium.

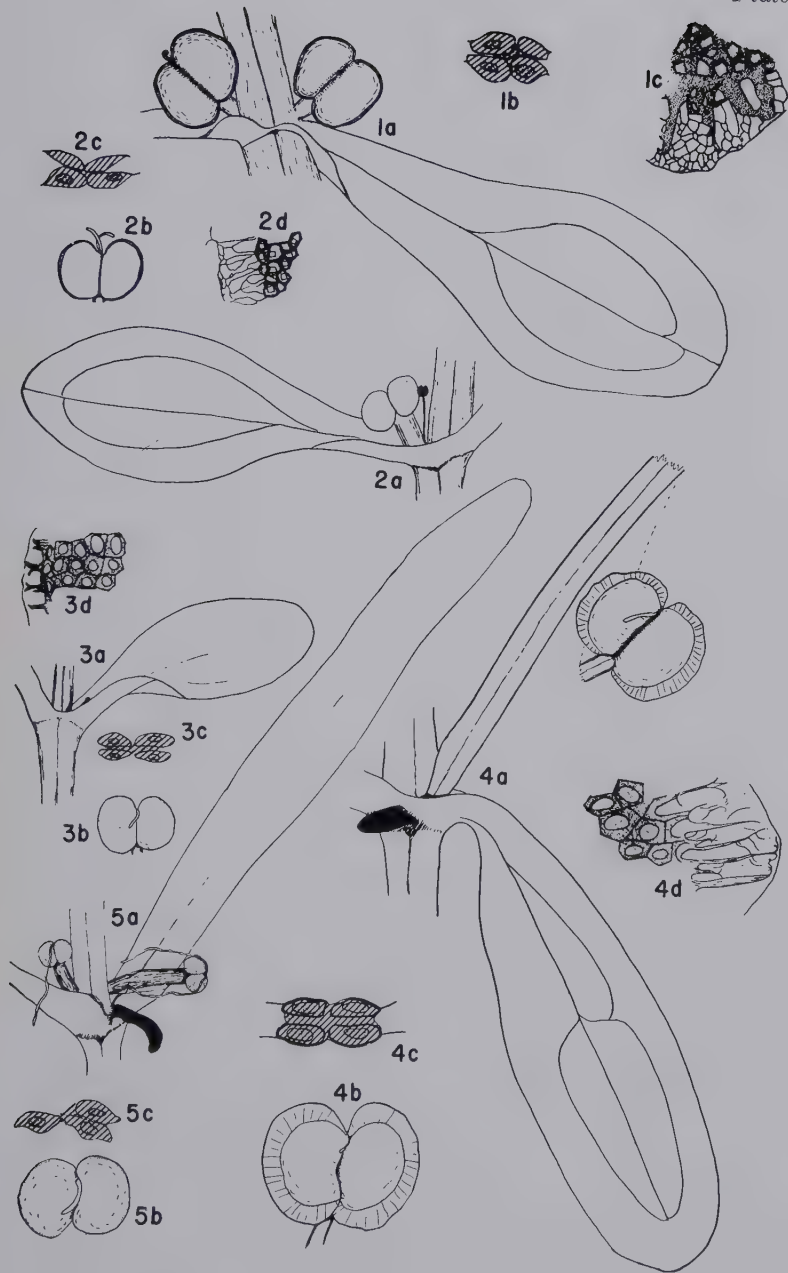
Fig. 1. *C. anceps*. Labrador, Fernald, Wiegand & Long 28640. Fig. 2. *C. anceps*. Labrador, Fernald & Wiegand 3649. Fig. 3. *C. anceps*. Newfoundland, Fernald & Wiegand 3657. Fig. 4. *C. anceps*. Newfoundland, Robinson & Schrenk in 1884. Fig. 5. *C. anceps*. Newfoundland, Gilbert & Hotchkiss 28638. Fig. 6. *C. anceps*. Quebec, Victorin, Rolland & Jacques 33330. Fig. 7. *C. anceps*. Quebec, Fernald & Collins 234 (TYPE). Fig. 8. *C. anceps*. Georgia, Svenson 7507. Fig. 9. *C. anceps*. Quebec, Fernald & Smith 25879. Fig. 10. *C. turfosa*. Chile, Johnston 5187. Fig. 11. *C. antarctica*. Marion Island, Mosley. Fig. 12. *C. marginata*. California, Mason 6810. Fig. 13. *C. deflexa*. Brazil, Rudão (ISOTYPE). Fig. 14. *C. sepulta*. Oregon, Hall 459 (TYPE).



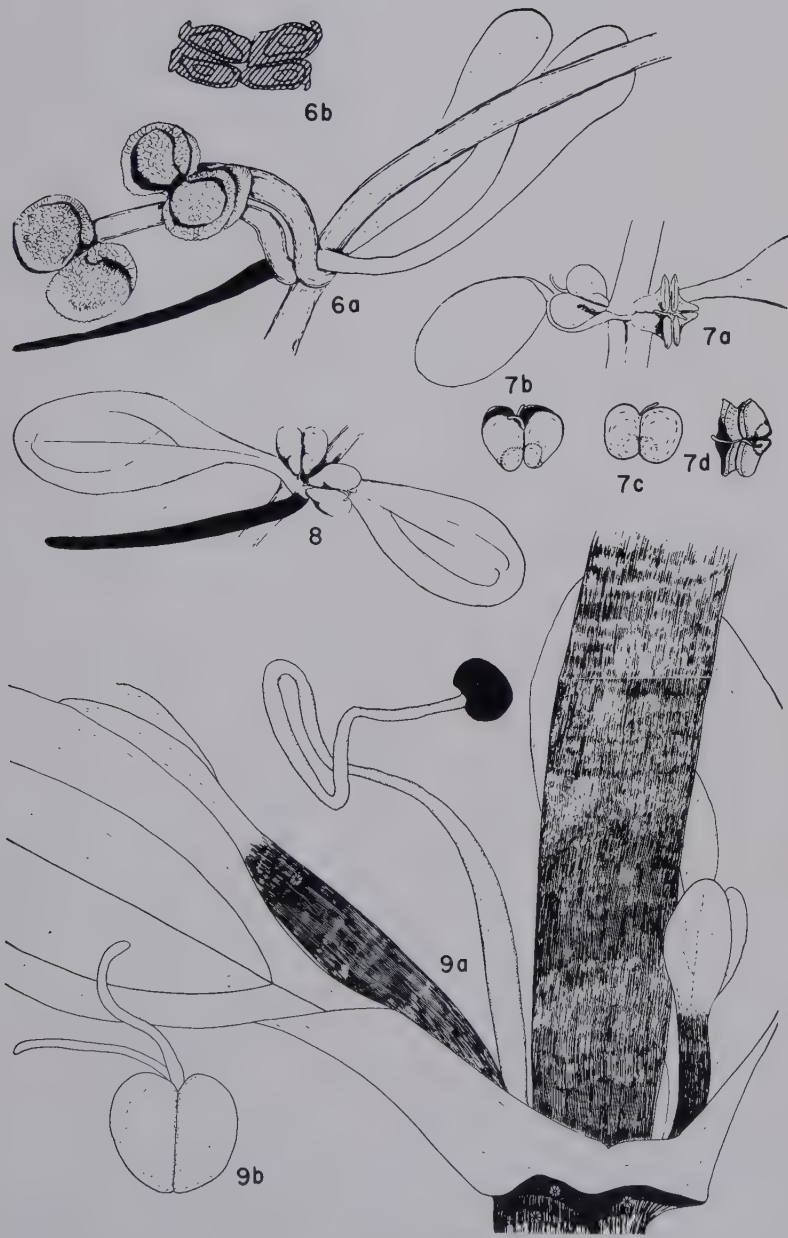
CALLITRICHE HETEROPHYLLA



CALLITRICHE. 1-9, *C. ANCEPS*. 10, *C. TURFOSA*. 11, *C. ANTARCTICA*. 12, *C. MARGINATA*. 13, *C. DEFLEXA*. 14, *C. SEPULTA*.



CALLITRICHE. 1, *C. TURFOSA*. 2, *C. DEFLEXA*. 3, *C. TERRESTRIS*. 4, *C. MARGINATA*. 5, *C. SEPULTA*.



CALLITRICHE. 6, *C. NUTTALLII*. 7, *C. PEPLOIDES*. 8, *C. OCCIDENTALIS*. 9, *C. ANTARCTICA*.

pedicels was mentioned as the typical form. Three years later this concept was reaffirmed; the plant with stalked fruits was treated as α *Brauniana*, with *C. deflexa* A. Br. as a synonym, and the sessile-fruited plants of both continents separated as β *Austini*. For *Austini* three cotypes¹ were listed, from Missouri, New Jersey and Pennsylvania, so if the sessile-fruited plants of the United States are separated from those of Central and South America, the name *Austini* belongs with the former.

C. deflexa var. **deflexa**. *C. deflexa* α *Brauniana* Hegelm. Verhandl. Bot. Ver. Brandenburg 9: 15. 1867; Hegelm. in Martius, Fl. Bras. 13, pt. 2: col. 13. 1882. *C. deflexa* β *Glaziovii* Hegelm. in Martius, l. c.—Fruit (0.5–) 0.7–0.9 mm. wide, (0.3–) 0.5–0.7 mm. high, on stalks 0.5–4 mm. long.—East coast of South America from Rio de Janeiro to Buenos Aires. **Brazil**: Rio de Janeiro, 1859–60, *Dr. Rudio* (ex herb. A. Braun, and probably ISOTYPES, MO, CM, GH); Curitiba, Paraná, 2. 10. 1914, *P. Dusén* (G. Jönsson written on some labels) 1044a (MO, GH, CM, US, NY); Rio Grande do Sul, São Leopoldo, August, 1941, *Leite* 2796 (GH) & 613 (NY); Santo Amaro, Cap., S. Paulo, Sept. 14, 1944, *Roth* 939 (sp). **Uruguay**: Montevideo, Nov., 1936, *Herter* 696a (CM, MO). **Argentina**: LaPlata, Provincia de Buenos Aires, Oct. 19, 1943, *Cabrera* 9805 (LP—mixed with var. *subsessilis*).

While the fruits are consistently larger than those of the next variety, an occasional individual has some of the fruits, ap-

PLATE 1170

(Numbers same as in keys and descriptions)

1. *C. turfosa*. 1a. Node, leaves and fruit, \times 30. Argentina, *Eyerdam* & Beetle 22385 (GH). 1b. Cross-section of fruit, \times 30. Same collection. 1c. Portion of wing and face of fruit, \times 187.5. Chile, *Johnston* 5187 (GH).
2. *C. deflexa* var. *subsessilis*. 2a. Node, leaves, stamens and young fruit, \times 30. Colombia, *Fassett* 25071 (WIS). 2b. Face of fruit, \times 30. Same collection. 2c. Cross-section of fruit, \times 30. Same collection. 2d. Portion of wing and face of fruit, \times 187.5. Same collection.
3. *C. terrestris*. 3a. Node, leaves and stamen, \times 30. Illinois, *Chase* 3903 (GH). 3b. Face of fruit, \times 30. Same collection. 3c. Cross-section of fruit, \times 30. Same collection. 3d. Portion of wing and face of fruit, \times 187.5. Same collection.
4. *C. marginata*. 4a. Node, leaf, young root, and pedicelled fruit, \times 30. California, *Tracy* 1870 (UC). 4b. Face of fruit, \times 30. California, *Tracy* 1876 (UC). 4c. Cross-section of fruit, \times 30. California, *Johnston* 1948 (UC). 4d. Portion of wing and face of fruit, \times 187.5. California, *Tracy* 3137 (UC).
5. *C. sepulta*. 5a. Node, leaf, young fruits, and young root, \times 30. Oregon, *Hall* 459 (GH). 5b. Face of fruit, \times 30. Same collection. 5c. Cross-section of fruit, \times 30. Same collection.

PLATE 1171

(Numbers same as in keys and descriptions)

6. *C. Nuttallii*. 6a. Portion of stem, leaves, root, and pedicelled fruits, \times 30. Alabama, *Mohr* on March 18, 1892 (NY). 6b. Cross-section of fruit, \times 30. Same collection.
7. *C. peploides*. 7a. Node, leaves and fruits of var. *peploides*, \times 30. Louisiana, *Langlois* in 1891 (NY). 7b. Face of fruit of var. *semialata*, \times 30. Honduras, *Standley* 56535 (CM). 7c. Face view of fruit of var. *media*, \times 30. Guatemala, *Standley* 83331 (CM). 7d. Top view of fruit, \times 30. Same collection.
8. *C. occidentalis*. Portion of stem, leaves, root, fruits, \times 30. Cuba, *Britton* & *Wilson* 4515 (NY).
9. *C. antarctica*. 9a. Portion of stem, leaves, axillary buds, and stamen, \times 30. Kerguelen's Land, *Küdder* in 1874 (US). 9b. Face of fruit, \times 30. Same collection.

¹ Cf. Blake, *Rhodora* 45: 481–485. 1943.

parently mature, only about 0.5 mm. wide and 0.3 mm. high. Other parts of the same plant may bear fruits of normal size. *C. deflexa* var. *Glaziovii* was probably based on material with such small fruits; the collections cited by Hegelmaier have not been seen.

***C. deflexa* var. *subsessilis* n. var.**, fructibus 0.5–0.7 (–0.8) mm. latis, 0.3–0.5 (–0.6) mm. altis, cum alis 0.03–0.05 mm. latis; pedicillis 0.1–0.3 mm. longis. Fruits 0.5–0.7 (–0.8) mm. wide, 0.3–0.5 (–0.6) mm. high, with wings 0.03–0.05 mm. wide, and on pedicels 0.1–0.3 mm. long. *C. deflexa* β *Austini* Hegelm. Verhandl. Bot. Ver. Brandenburg 9: 15. 1867, and in Martius, Fl. Bras. 13, pt. 2: col. 13. 1882, as to South American plants but excluding the North American cotypes.—From Central Mexico southward to Argentina. **Mexico:** Nanchititla, Temascaltepec, 10–11–33, *Hinton 4988* (GH). **Guatemala:** Volcán Jumay, Jalapa, alt. 1300–2200 m., Dec. 1, 1939, *Steyermark 32440* (CM, NY); Guatemala, alt. 1500 m., Jan. 20, 1939, *Steyermark 63106* (CM); Tajumulco, Dept. San Marcos, alt. 2300–2500 m., *Steyermark 36581* (CM). **Honduras:** Dept. Morazán, Río Yeguaré, near El Zamorano, about 800 m., Feb. 27, 1947, *Standley & Molina 4671* (CM). **Colombia:** east of Bata, valley of Río Chitagá, southwest of Pamplona, Dept. Norte de Santander, alt. 6500 ft., Oct. 13, 1944, *Fassett 25932* (TYPE in MO; CM, GH, US, NY, WIS); Vélez, Dept. Santander, April 17, 1944, *Fassett 25071* (MO, GH, WIS); Tequendama, Dept. Cundinamarca, Oct. 28, 1917, *Pennell 2648* (NY). **Brazil:** Caldas, prov. Minas Geraes, Sept. 22, 1867, *Regnell 1578* (NY, US, CM); Bello Jardim, Serra do Genipapo, Pernambuco, Nov. 14–15, 1924, *Chase 7710* (US); Ouro Preto, *Gomes 1751* (CM); Itatiba, S. Paulo, Nov. 26, 1930, *Leme 26697* (SP); Moóca, Cap., S. Paulo, Nov., 1912, *Brade 5778* (SP); Bahia, *Salzman* (MO). **Bolivia:** Región de Mapiiri, San Carlos, Nov. 26, 1926, *Buchtien 1830* (NY). **Paraguay:** without locality, *Jørgensen 4509* (MO); Sud-Paraguay, *Kuntze* (NY). **Argentina:** Formosa, Aug., 1919, *Gonzalez 3240* (US, GH); Prov. Tucumán, Dept. Capital, 450 m., Aug. 1923, *Venturi 2052* (GH, US); Sierra de San Javier 14 kms. al oeste de Tucumán, July 14, 1949, *O'Donnell, Araque & Barkley 19A000* (US); Chaco, July, 1941, *Schulz 2996* (LP); Ribera de Río de La Plata, Isla Santiago, Oct. 12, 1931, *Cabrera 1781* (LP); La Plata, Provincia de Buenos Aires, Oct. 19, 1943, *Cabrera 9805* (LP—mixed with var. *deflexa*).

3. ***C. terrestris* Raf. emend. Torr.** *C. terrestris* Raf. in Med. Repos. N. Y. 5: 358. 1808, *nomen ambiguum*; Torr. Comp. Fl. N. & Middle States 14. 1826; DC. Prod. 3: 71. 1828; House, N. Y. State Mus. Bull. no. 254: 473. 1924. *C. deflexa* A. Br. in Hegelm. Monogr. Callit. 58. 1864, as to some North American plants, not as to South American type. *C. deflexa* β *Austini* Hegelm. Verhandl. Bot. Ver. Brandenburg 9: 15. 1867, as to cotypes from Missouri and New Jersey, excluding cotype from Pennsylvania (*Moser*, 1832) and references to plants from South America; Morong, Bull. Torrey Club 18: 234. 1891; Robinson & Fernald in Gray's Manual, ed. 7: 550. 1908; Fassett, Man. Aquat. Pl. 241. 1940; Fernald in Gray's Manual, ed. 8: 973. 1950. *C. Austini* Engelm. apud Gray, Man. ed. 5: 428. 1867; Chapman, Fl. S. U. S., ed. 3: 420. 1897; Britton & Brown, Ill. Fl. North. States & Canada, vol. 2: 382. 1897; Small, Fl. Southeastern U. S. 723. 1903.—Fruit 0.6–0.9 mm. wide, 0.4–0.7 mm. high, on pedicels mostly 0.2 mm. long, rarely reaching 0.6 mm. long; mericarps usually equally rounded at each end (Fig. 3b) but rarely more broadly rounded above so that the fruit becomes slightly heart-shaped; faces of mericarps flat

(Fig. 3c); outer edges of mericarps appearing scarcely winged but under high magnification showing a very narrow wing with radii, but little anastomosing of radii (Fig. 3d); stigmas 0.2–0.4 mm. long, usually persistent and deflexed (Fig. 3b); anthers 0.1–0.2 mm. wide, on filaments 0.1–0.2 mm. long; leaves rather uniform, obovate-oblongate to spatulate, 2–3.5 mm. long, 0.6–1 mm. wide, very obscurely 3-nerved (Fig. 3a).—On damp soil, moist pathways, etc.; western Massachusetts and Connecticut to southeastern Virginia, westward in the mountains of Virginia, western Pennsylvania, northern Ohio, and in the Mississippi Valley from southern Indiana, northern Illinois and northern Missouri to Louisiana; apparently isolated in western Alabama. About half the collections examined are listed below. **Massachusetts:** Sunderland, Franklin Co., July 10, 1929, *Seymour 3385* (GH); Longfellow Park, Cambridge, July 1, 1945, *Hartman* (NEBC). **Connecticut:** Fairfield, July 22, 1898, *Eames 36* (US, GH); Southington, June 23, 1901, *Bissell* (GH); Southport, alt. 2–6 ft., July 17, 1891, *Eames 35* (GH). **New York:** Staten Island, May 26, 1889, *Britton* (NY). **New Jersey:** top of hills, Staten Island, N. Y., & Weehauken, N. J., June, 1842, *Austin* (NY, obviously two collections but no indication as to which is which); Palisades, Oct. 1864, *Austin* (MO—probably cotype *C. deflexa* var. *Austini*); Bergen Co., June 17, 1865, *Parker* (CM); Milltown, Middlesex Co., May 17, 1908, *Mackenzie 3059* (US). **Pennsylvania:** York Co., July 2–6, 1904, *Britton* (NY); Sellersville, 1883, *Fretz* (MO); Pittsburg, June 28, 1905, *Jennings & Kinzer 132* (MO). **Delaware:** Wilmington, June 15, 1881, *Commons* (GH, MO, US, NY); Townsend, *Canby* (CM); Leipsig, June 13, 1937, *Tatnall 3409* (GH). **Maryland:** Clinton, May 19, 1920, *Holm* (GH); Cecil Co., June 13, 1876, *Commons* (CM). **District of Columbia:** Brookland, May 10, 1896, *Holm* (US); Corcorans Woods, June 25, 1882, *Ward* (US). **Virginia:** Skipper's, Greensville Co., May 21, 1939, *Fernald & Long 9968* (MO, GH, US, NY); Mt. Vernon, July 4, 1889, *Coville* (US); Stony Creek, Sussex Co., May 11, 1940, *Fernald & Long 11869* (GH); North Landing, Norfolk Co., May 6, 1935, *Fernald & Griscom 4447* (GH); Long Mt., Frederick Co., July 1, 1933, *Griscom & Hunnewell 18805* (GH). **Ohio:** Oberlin, Lorain Co., June 23, 1947, *Fassett 27645* (WIS). **West Virginia:** Petersburg, Grant Co., July 10, 1940, *Sharp & Fox* (WVA). **Kentucky:** Mammoth Cave, May 30, 1897, *Barnhart 2292* (NY); Hawesville, May 15, 1937, *Wadmond, Fassett, Curtis & Dunlop 21470* (WIS); Paducah, May 30–June 20, 1909, *Eggleston 4465* (NY). **Tennessee:** Nashville, May, *Gattinger 2463* (CM, MO, US, GH, NY); Chester Co., June, 1892, *Bain* (US); Memphis, May 20, 1851, *Fendler* (MO). **Alabama:** Auburn, Lee Co., April 16, 1898, *Earle & Baker* (MO, mixed with *C. Nuttallii*). **Indiana:** Henryville, Clark Co., June 18, 1935, *Hermann 6754* (GH); Leavenworth, Crawford Co., June 16, 1935, *Hermann 6685* (NY); Princeton, June 14, 1935, *Hermann 6607* (US). **Illinois:** Peoria, May 28, 1922, *Chase 3903* (GH); Menard Co., June 1878, *Hall* (CM); Mt. Carmel, May 9, 1888, *W. T. [release]* (MO); Richland Co., April 23, 1926, *Ridgeway 2482* (MO); Giant City State Park, Jackson Co., May 14, 1937, *Fassett 21471* (WIS); Cobden, Union Co., May 23, 1902, *Earle 699* (NY). **Missouri:** banks of the Mississippi south of the Meramec, May 28, 1864, [*Engelmann*] (MO, US, CM—probably COTYPE of *C. deflexa* var. *Austini*); Molino, Audrain Co., May 14, 1939, *Steyermark 22468* (CM); Eagle Rock, Barry Co., June 12, 1897, *Bush 64* (MO, US); Coloma, Carroll Co., June 25, 1938, *Steyermark 6195* (CM); Dunklin Co., May 17, 1892, *Bush* (MO); Gray Summit, Franklin Co., June 20, 1928, *Kellogg 1835* (MO); Grain Valley, June 19, 1898, *Bush 90* (MO, NY); Sarcxie, Jasper Co., May 19, 1912, *Palmer 3681* (MO); Jasper, Jasper Co., July 17, 1910, *Palmer 3015* (MO); Foley,



2a (lower right). *C. deflexa* var. *subsessilis* in Mexico and Central America. 3 (upper right). *C. terrestris*. 4 (left). *C. marginata*.

Lincoln Co., May 25, 1933, *Steyermark* 8132 (mo); Victor, Monroe Co., May 31, 1936, *Steyermark* 10933 (mo); Starland, Perry Co., April 21, 1938, *Steyermark* 4946 (mo, cm); Jerome, Phelps Co., May 13, 1914, *Kellogg* 415 (mo, NY); Jonca Creek, Ste. Genevieve Co., May 30, 1933, *Steyermark* 8802 (mo); Tyrone, Texas Co., June 1, 1935, *Steyermark* 19184 (mo). **Arkansas:** Fayetteville, June, 1835, *Engelmann* (mo, GH); Little Rock, April, 1886 (NY); Monticello, Drew Co., May 14, 1939, *Demaree* 19120 (mo); Imboden, May 14, 1924, *Wheeler* 53 (cm); Pinnacle, June 1, 1923, *Wheeler* 82 (cm). **Louisiana:** Lake Charles, April 25, 1884, *Langlois* (NY); Calcasien, April, 1884, *Langlois* (mo). **Oklahoma:** McCurtain Co., June 16, 1930, *Little & Olmsted* 662 (us).

Rafinesque's original description of *C. terrestris* did not mention fruit and was obscure: "stem procumbent spreading, leaves entire, thick, petioled, oblong, obtuse flowers monoiceous, it is

found in some moist grounds in New-Jersey and Pennsylvania." This might be considered to be either the plant described nearly 60 years later as *C. Austini* or else a terrestrial form of *C. heterophylla*. The latter, however, has the *thin* and *veiny* leaves petioled and rotund, or else sessile and linear. It seems probable, then, that *C. terrestris* was not *C. heterophylla*, in which case it could be only the plant later known as *C. Austini*.

Happily, before any other names appeared on the scene, *C. terrestris* was unquestionably applied in the present sense, by Torrey in 1826 and by DeCandolle in 1828.

Torrey described 3 species: (1) *C. verna* β *intermedia* with margin of the capsule obtuse and upper leaves spatulate-obovate, i. e., *C. heterophylla* of present treatments; (2) *C. autumnalis* with "leaves all linear, 1-nerved, . . . capsule with an acute margin . . . superior leaves a little broader and 3-nerved"—probably a mixture of *C. verna* and *C. hermaphroditica*; and (3) *C. terrestris*, "procumbent, diffuse; leaves oblong, uniform, rather obtuse; capsule grooved on the margin . . . capsule very short, and broad," i. e., the plant later described as *C. Austini*. The clear description by Torrey can, then, be taken as fixing the application of the name *C. terrestris* Raf.

The application of *C. terrestris* as fixed by Torrey was followed two years later by DeCandolle. He had four species: (1) *C. verna*, with "carpellorum dorso obtusiusculo," from both Europe and North America, probably including both *C. verna* and *C. heterophylla* as understood today; (2) *C. pedunculata* of Europe; (3) *C. autumnalis*, the *C. hermaphroditica* of the present treatment; and (4) *C. terrestris*, with "fructibus sessilibus latis brevibus emarginatis," which could be, again, only the *C. Austini* of later treatments.

In *Rhodora* 43: 589. 1941, Fernald warned against use of the name *C. terrestris* for the "barely separable variety of the South American *Callitriche deflexa*," on the basis of certain statements by Hegelmaier in 1867. He quotes Hegelmaier that "Was in den Herbarien unter dem Namen *C. terrestris* Raf. liegt, sind Landformen verschiedener Species, namentlich auch von *C. verna* und *heterophylla*." But if the presence of misidentified specimens in many herbaria were to be considered as fixing the application of names, the nomenclature of *Callitriche* would be even

more complex than it is now. Hegelmaier, indeed, did not advance this as a reason for ruling *C. terrestris* from consideration. Perhaps Rafinesque had mixed material, he says, but certainly the *C. terrestris* of DeCandolle was this species—"Es ist nicht unwahrscheinlich, dass, wo nicht Rafinesque, so doch Decandolle im Prodrömus die Form β unter seiner *C. terrestris* verstanden hat." If, continues Hegelmaier, one could demonstrate that DeCandolle had original material from Rafinesque, which one cannot do at present—"wenn sich wirklich nachweisen liesse, dass Decandolle hierbei originalien von Rafinesque vorgelegen haben, was ich zo thun jetzt nich im Stande bin," then *C. terrestris* Raf. should be taken up as having priority over *C. deflexa* and β *Austini*.

Whether or not DeCandolle's use of the name *C. terrestris* was guided by posession of Rafinesque's material is academic: we can take the use of the name by Torrey and by DeCandolle as fixing its use, long before the publication of *C. deflexa* and *C. Austini*.

C. deflexa β *Austini*, as described by Hegelmaier, was constituted of several elements. It embraced two distinct entities, i. e., *C. terrestris* (plants from Missouri, New Jersey, Arkansas, and perhaps New York and Texas) and *C. deflexa* var. *subsessilis* (Mexico, Brazil). Of the four collections cited (cotypes), one, *C. J. Moser* from Philadelphia, is *C. heterophylla*.

4. *C. marginata* Torr. U. S. Rept. Expl. Miss. Pacific 4: 135. 1857; Hegelm. Verhändl. Bot. Ver. Brandenburg 9: 12. 1867; Wats. Bot. Calif. 2: 76. 1880; Morong, Bull. Torrey Club 18: 235. 1891; Jepson, Fl. Calif. 2, pt. 7: 433. 1936; Peck, Man. Higher Pl. Ore. 466. 1941. *C. marginata* α *Torreyana* Hegelm. l. c. *C. Nuttallii* Jepson l. c., 434, not Torr.—Fruits on somewhat inflated pedicels of varying lengths, often buried in the mud at maturity, 0.8–1.2 mm. wide and not quite so high (Fig. 4a); wing 0.1–0.2 mm. wide, sometimes very sharply differentiated from the surface of the mericarps (Fig. 4b); stigmas 1 mm. or less long, sharply deflexed, persistent (Fig. 4a) or caducous (Fig. 4b); leaves nearly uniform, spatulate, the largest 3.5–8 mm. long and 0.8–2 mm. wide, 1–3-nerved (Fig. 4a).—Usually on the mud at the edge of pools, less commonly in the water; northern Oregon to northern Lower California. **Oregon:** The Dalles, 1884, *Howell* (GH); Grant's Pass, *Howell* (GH). **California:** Valley Springs, Calaveras Co., April, 1930, *Mason 5544* (UC); Princeton, Colusa Co., May 2, 1902, *Heller & Brown 5440*, distributed as *Elatine brachysperma* (US, GH, NY, CM); Walnut Creek, Contra Costa Co., March 16, 1932, *Mason 6810* (UC, GH); Deer Valley, Briones Road, Contra Costa Co., March 20, 1932, *Mason 6852*, mixed with *C. longipedunculata* (UC, GH); "Connick claim," 4 miles S. E. of Eureka, alt. 0–500 ft., May 23, 1909, *Tracy 2975*, mixed with *C. heterophylla* var. *Bolanderi* (UC); Miranda, Humboldt Co., alt. 400 ft.,

March 29, 1925, *Tracy* 6948 (UC); Salmon Creek Valley, around Humboldt Bay, alt. 100 ft., June 17, 1917, *Tracy* 4823 (UC); Santa Monica, *Hasse* 4795 (NY); Olema to Bolinas Road, Marin Co., March 1, 1932, *Mason* 6805 (UC); Ignacio, Marin Co., alt. ca. 20 ft., April 18, 1946, *Rose* 46039 (MO); Ukiah, Mendocino Co., 1866, *Bolander* 4658 (UC—mixed with another sterile species, MO); Fort Bragg, Mendocino Co., June, 1930, *Mason* 5641 (UC); Merced to Snelling, Merced Co., March 16, 1932, *Normay* 706b (UC); Calistoga, Napa Co., May 15–18, 1903, *Tracy* 1870 (UC, US); Pacific Grove, Monterey Co., May 1, 1907, *Heller* 8500, distributed as *Elatine brachysperma* (US, GH, NY, CM); Sacramento, April 3, 1934, *Copeland* (UC); Elsinore Mts., Riverside Co., May 18, 1941, *Munz* 16658 (MO); Red Hill near Upland, San Bernardino Co., May 4, 1917, *Parish* 11153 (UC, GH); Red Hill, April 28, 1917, *Johnston* 1756 (UC, GH); Mt. Soledad, La Jolla, San Diego Co., March 2, 1922, *Wiegand & Upton* 3768 (CM); Mesas, San Diego Co., April 25, 1884, *Orcutt*, TYPE of *C. longipedunculata*, but mixed with *C. marginata* (GH) or consisting entirely of *C. marginata* (US); Waverly, San Joaquin Co., 1890–91, *Sanford* 360 (UC); Searsville, 1866, *Bolander* 78, mixed with *C. heterophylla* (GH); French Camp, San Joaquin Co., 1890–91, *Sanford* 91 (MO); Bloomquist's Mill, San Mateo Co., April 23, 1927, *Mason* 3697 (UC); Pacheco Pass, Santa Clara Co., April 17, 1932, *Mason* 6961 (UC); Mark West's Creek, Sonoma Co., April 30, 1854, *Bigelow* (COTYPE in GH, MO, US, NY); Puerta Cañon, Stanislaus Co., June 11, 1862, *Brewer* 1256 (MO, UC, US); Modesto, Stanislaus Co., March 15, 1935, *Hoover* 323 (UC); without locality, *Rev. A. Fitch* (COTYPE in US, MO, NY). **Baja California:** Guadaloupe ranch, northern Lower California, April 6, 1886, *Orcutt* (MO).

The habitat, to judge from the well-annotated material in the Herbarium of the University of California, is mainly on the drying mud of vernal pools. This species has been much confused with *C. longipedunculata*, which also grows in vernal pools but is more often in permanent standing water. *C. longipedunculata* may apparently be found in the water of a pool while *C. marginata* prefers the muddy shore; fluctuations in water level undoubtedly bring about a mixing of the two. Several collections, including the type of *C. longipedunculata*, are mixed; it is not possible to determine whether they actually grew with their stems intertwined or if the collector took a handful from the shore and another from the water.

(To be continued)

PLANTS FROM THE VICINITY OF
FAIRBANKS, ALASKA(Contributions to the Flora of Alaska, No. 1)¹LOUIS H. JORDAL²

DURING the month of July, 1950 the author was delayed a few days while awaiting transportation into the Brooks Range region from Ladd Air Force Base, Fairbanks. These were spent mostly in preparing supplies and equipment for the botanical enterprises in the Brooks Range on which I have been engaged for two years under the auspices of the Botanical Gardens, University of Michigan.³

On a few occasions during this period, with my brother, Mr. Odd Jordal, I had an opportunity to collect a few numbers in the immediate vicinity of Fairbanks. The present account lists about 50 different species, some of which have not been reported from Alaska previously. This list does not fit well into a report on the vegetation of the Brooks Range which is now under preparation, and for that reason it is published separately.

LIST OF THE PLANTS

TYPHA LATIFOLIA L. Dense stands in shallow water along margins of bog-lake near Chena Slough, July 12, 1950, no. 3537.

Strangely enough this species is not included in Hultén's Flora of Alaska in spite of the fact that it is rather common in paludose situations in the vicinity of Fairbanks which perhaps is its northernmost station in America.

SPARGANIUM MINIMUM (Hartm.) Fr. In dried-up bed of bog-pond, no. 3528.

POTAMOGETON FILIFORMIS Pers. var. *BOREALIS* (Raf.) St. John. Submersed in swift water, Chena Slough, no. 3542.

TRIGLOCHIN PALUSTRE L. Scattered on wet, mossy banks of Chena Slough, no. 3547.

GLYCERIA MAXIMA (Hartm.) Holmb. Scattered on bare, silty ground, no. 3539.

¹ Paper No. 937 from the Department of Botany, University of Michigan.

² Research Assistant, Botanical Gardens, University of Michigan.

³ The author is indebted to the Arctic Institute of North America for the grant-in-aid which made the botanical activities of 1950 possible and to the Director of the Botanical Gardens, University of Michigan, for continuous aid and support in exploring the flora of Alaska.

Lemmas 2.5–3 mm. long; stamens 1–1.3 mm. long. Hulten (Fl. Al. pt. II: 229) would relegate *G. grandis* Wats. to subspecific status under *G. maxima*. Recently Church (Am. Jour. Bot. 36: 155–165, 1949) has reviewed the genus for North America and reports that *G. maxima* is a hexaploid while *G. grandis* is a diploid. The quantitative features enumerated by that author as differentiating the two clearly set them apart and is it therefore better to regard them as two separate species.

ERIOPHORUM SCHEUSCHZERI Hoppe. Open stands along silty banks of Chena Slough, no. 3534.

SCIRPUS MICROCARPUS Presl. Scattered on bare, silty ground, no. 3538.

In the National Herbarium, Wash. D. C. there is a specimen of this species from Fairbanks (*Scamman* no. 1644). My record seems to be the second one of this otherwise coastbound species from interior Alaska.

ELEOCHARIS PALUSTRIS (L.) R. and S. Dense tufts in bed of overflow channel, no. 3533.

CAREX ATHROSTACHYA Olney. Small tufts in bed of overflow channel, no. 3525.

This appears to be the first record of this species from interior Alaska.

CAREX CANESCENS L. Dense tufts on wet, low banks of Chena Slough, no. 3532.

CAREX DIANDRA Schrank. Dense tufts along low, wet banks, no. 3560.

CAREX MEDIA R. Br. Large, dense tufts in moist alder and willow thickets along road, no. 3531.

JUNCUS FILIFORMIS L. Dense, small tufts in dry, open situations, no. 3526.

PLATANATHERA HYPERBOREA (L.) Lindl. Scattered on high, dry banks of Chena Slough, no. 3545.

SALIX MYRTILLIFOLIA Anders. Low ascending shrub along dry roadsides, no. 3552.

POLYGONUM CONVULVULUS L. Prostrate on bare, moist and silty ground near Chena Slough, no. 3530.

CHENOPODIUM CAPITATUM (L.) Aschers. Along roadsides, no. 3540.

MOEHRINGIA LATERIFLORA (L.) Fenzl. Dense tufts on bare soil in dry, open situations, no. 3544.

SPERGULA ARVENSIS L. Scattered in dry, open field on slopes above Chena Slough, no. 3520.

SILENE WILLIAMSII Britton. Low, dense tufts on dry gravelly slope, no. 3510.

NYMPHAEA TETRAGONA Georg. ssp. LEIBERGII (Morong) Pors.

In the private collection of an enthusiastic amateur botanist, Mrs. Jack Bollerud at Ladd Air Force Base, I discovered a

specimen of the above species said to have been collected near Fairbanks. This species is not reported in Hulten's Flora.

CALTHA NATANS Pallas. Prostrate in dried-up bed of bog-pond, no. 3529.

DELPHINIUM GLAUCUM Wats. Scattered on slope within open stand of mixed-forest, no. 3561. Follicles strongly villous on the sutures, sparsely long pilose throughout.

RANUNCULUS HYPERBOREUS Rottb. Prostrate in wet, lowland depressions, no 3516.

RANUNCULUS SCELERATUS L. var. *MULTIFIDUS* Nutt. Scattered on bare, moist silt along banks of Chena Slough, no. 3517.

RANUNCULUS PENNSYLVANICUS L. f. Scattered in bed of overflow channel, no. 3523.

CORYDALIS AUREA Willd. On dry, gravelly slopes above Chena Slough, no. 3511.

ARABIS HIRSUTA (L.) Scop. var. *PYCNOCARPA* (Hopkins) Rollins. Along dry roadside, no. 3556.

ERYSIMUM CHEIRANTHOIDES L. Along dry roadside, no. 3555.

TORULARIA HUMILIS (Mey.) Schulz. Dense tufts on bare soil along dry roadside, no. 3553.

AMELANCHIER ALNIFOLIA (Nutt.) Nutt. Low shrub along dry roadside, no. 3507.

ASTRAGALUS ALPINUS L. var. *ALASKANUS* Hult. Dense decumbent tufts along dry roadside, no. 3515.

OXYTROPIS VARIANS (Rydb.) Hult. In dry, open field along banks of Chena Slough, no. 3551. This plant was kindly identified by Mr. A. E. Porsild.

EPILOBIUM ADENOCALON Hausskn. Scattered, in moist roadside situation, no. 3536.

EPILOBIUM PALUSTRE L. Scattered, in moist roadside situation, no. 3535; on wet banks of Chena Slough, no. 3546.

CIRCAEA ALPINA L. Dense stand in moist, lowland willow thicket, no. 3518.

ANDROSACE SEPTENTRIONALIS L. Diffuse tufts on dry, gravelly slope, no. 3514.

APOCYNUM ANDROSAEMIFOLIUM L. In dry field above Chena Slough, no. 3513.

COLLOMIA LINEARIS Nutt. On bare soil along dry roadside, no. 3548.

DRACOCEPHALUM PARVIFLORUM Nutt. Dense tufts on dry, gravelly slope, no. 3509.

SCUTELLARIA GALERICULATA L. var. *epilobiifolia* (Hamilt.) Jordal comb. nov. Basynym *S. epilobiifolia* Hamilt. In overflow channel with rank berbs, no. 3522.

It is clear from Epling's discussion in *Am. Jour. Bot.* **26**: 17, (1939) that this species exhibits a different mode of variation in America than it does in Eurasia although one must agree that the differences exhibited by the American populations are not as specific as Fernald in *RHODORA* **23**: 85 (1921) makes them. Nevertheless, it is this writer's opinion, based on field experiences both in North America and Scandinavia that the high grown,

thin-leaved type which is so frequently found in the Western Hemisphere is sufficiently distinct from the average European material to warrant status as a geographical race, i. e. as variety. The American material differs "consistently from the Eurasian *S. galericulata* in the low pebbling of the nutlets," according to Fernald in Gray's Manual of Botany, 8th ed. p. 1221.

VERONICA SCUTELLATA L., f. *VILLOSA* (Schum.) Pennell. Scattered, in dry open fields above Chena Slough, no. 3543.

This species is known from the Yukon but has not been reported from Alaska before. It appeared to be quite common in dry, open situations near Fairbanks.

CASTILLEJA *PALLIDA* (L.) Spreng. ssp. *CAUDATA* Pennell. On high, dry banks of Chena Slough, no. 3558.

EUPHRASIA SUBARCTICA Raup. Scattered, along dry, open roadside, no. 3527.

UTRICULARIA MACRORHIZA Le Conte. Immersed in lowland bog-pond, no. 3524. Plants blooming profusely.

PLANTAGO MAJOR L. Common weed along dry roadsides, no. 3557.

GALIUM TRIFIDUM L. With rank herbs in overflow channel, no. 3521.

ANTENNARIA OXYPHYLLA Greene. Dense colonies on dry, sandy slopes above Chena Slough, no. 3508. This plant was kindly identified by Mr. A. E. Persild.

ARTEMISIA FRIGIDA Willd. Dense tufts on dry, gravelly slopes above Chena Slough, no. 3509.

ARNICA ALPINA (L.) Olin, ssp. *ATTENUATA* (Greene) Maguire. On dry slopes in open mixed-forest on low hill, no. 3559.

SENECIO PAUCIFLORUS Pursh. Along dry roadside, no. 3550. Plants unusually tall and coarse.

SAUSSUREA ANGUSTIFOLIA DC., f. *RAMOSA* f. nov. A forma typica caulibus altis ramosisimis inflorescentiis longis ramosis, capitulus multis, differt.

Differs from the typical species in its tall, rank habit and in the long-branched, multi-headed inflorescence. Type in Herbarium, University of Michigan: along dry roadside near Fairbanks, July 13, 1950, *Jordal no. 3554*.

S. angustifolia is a very variable plant in Alaska. The form described above is an extreme one with the features enumerated.

CREPIS TECTORUM L. Weed along dry roadside, no. 3550.

This appears to be the first record of this common weed from Alaska.

PREVIOUSLY UNREPORTED PLANTS FROM MINNESOTA.—Three species and two color forms are herewith placed on record from St. Louis County.

Rhynchospora fusca (L.) Ait. f., Lakela 11043, was discovered on Aug. 3, 1950, in a quaking sedge-mat along Highway 35 at

Wahlsten, south of Tower, while I was collecting *R. alba*. The latter, in full anthesis whitened the habitat, in contrast to its rare congener already in full fruit. The sedge-mat surrounding a vanishing lake in the center of the spruce-tamarack bog, supported a remarkable association of species, rare and local in the area, e. g. *Triglochin palustris* L., *Carex limosa* L., *Eleocharis pauciflora* (Lightf.) Link., var. *Fernaldii* Svenson, and *Utricularia cornuta* Michx., encircling the open water in abundance, on each side of the highway, and filling the moss-pools with yellow blooms. In the interior of the continent, *R. fusca* is reported from Wisconsin, Michigan, and Ontario. Minnesota specimens are identical with those of Dr. N. C. Fassett, from Wisconsin.

Aster laevis L., f. *Beckwithiae* House, the white form, occurs with the typical form in the west central part of the county. Collection, Lakela 12070, was made in a mixed forest, terrace of Side Lake, of Sturgeon Lake, about 20 miles north of Hibbing. The flowers on drying turned pale lilac.

Cypripedium acaule Ait., f. *albiflorum* Rand & Redfield, a single plant with a wholly white flower, Lakela 10268, was discovered by Miss Mary I. Elwell among typical forms in lichen mats under pines on high granite ledges across the road from Kabetogama State Forestry Station, northwest part of the county, June 11, 1950. The flower on drying turned pinkish.

Penstemon pallidus Small, Lakela 10650, roadside vegetation on Highway 2, about 35 miles west of Duluth, July 1950, seems well established. The species has reached Minnesota from the southern states.

To the adventive flora is added *Potentilla intermedia* L., Lakela 11081, Aug. 2, 1950, growing in sand, on terrace of Armstrong Lake, south of Ely. It first came to attention on June 20, 1949, when the plants were in flower, Lakela 8303. The colony is established on the main trail to the tourist cabins.—OLGA LAKELA, University of Minnesota, Duluth Branch.

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